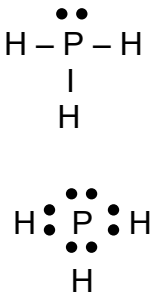
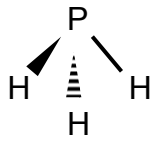
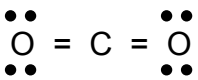
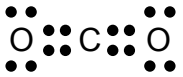
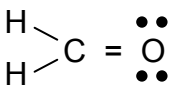
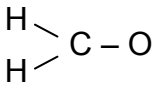
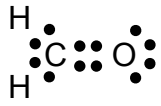
Demonstrate Understanding of Bonding, Structure & Energy Changes

Answers AS91164

ANSWER ONE *(Question p 2)*

(a)

Molecule	Lewis Structure	Diagram of Shape	Name of Shape
PH_3	 or		Trigonal pyramid
CO_2	 or 	O – C – O	Linear
H_2CO			Trigonal planar

	or 		

(b) In SO_2 the central atom has three regions of electron density (sets of electrons) around it. Two of these are bonding and one is non bonding. The non bonding pair contributes to the shape but is not considered part of the shape. The bond angle is 120º because the regions of electron density are arranged as far apart as possible from each other in a trigonal planar position.

In H_2S the central atom has four regions of electron density (sets of electrons) around it. Two of these are bonding and two are non bonding. These four regions repel each other as far apart as possible. The regions of electron density are arranged as far apart as possible from eah other in a tetrahedral position, which explains why the bond angle is 109º

(c) Both $CHCl_3$ and CH_2Cl_2 are polar molecules, which have four regions of electron density around the central C atom. These are all bonding pairs of electrons, so the shape of both molecules is tetrahedral.

The C – Cl bond is polar because of the difference in electronegativity between C and Cl. The C – Cl bonds are more polar than the C – H bonds because the electronegativity of Cl is greater than that of C or H.

ANSWER TWO *(Question p 2)*

(a)

Solid	Type of Solid	Type of Particle
Mg (magnesium)	Metallic	Atom
O_2 (oxygen)	Molecular	Molecule
MgO (magnesium oxide)	ionic	ion

(b) (i) $n(O_2) = \frac{15.4}{32} = 0.481$ mol

Energy released $= 0.481 \times 1200 = 578$ kJ

(ii) M(Mg) = 24.0 g mol^{-1}

1200 kJ is released by 2 mol Mg

so 1 kJ is released by $\frac{2}{1200}$ mol Mg

so 98.2 kJ is released by $98.2 \times \frac{2}{1200}$ mol Mg $= 0.164$ mol Mg

therefore the mass of Mg = 0.164 x 24.0 = 3.93 g

(c) The magnesium atoms are held together in a three dimensional lattice structure by metallic bonding in which valence electrons are attracted to the nuclei of neighbouring atoms.

The malleability of magnesium is due to the attraction between the valence electrons and the nuclei being non-directional. This means that the lattice structure remains intact as layers of atoms slide over each other while maintaining the metallic bond.

Magnesium is not soluble in water, because its metallic bonds are stronger than the attractive forces between the water molecules and the magnesium atoms.

Magnesium oxide does not conduct electricity in its solid form, because in this form its ions are not free to move (movement would allow the ions to carry the electric charge). When magnesium oxide is molten, movement of its ions permits it to carry an electric charge.

ANSWER THREE *(Question p 3)*

(a) This reaction is endothermic because energy is absorbed in order to break the attractive forces between molecules in the solid state, to result in a liquid state.

(b) (i) H – H bonds are broken; O – O bonds are broken; H – O bonds are formed.

(ii) Bond breaking is endothermic (energy is needed to separate the bonded atoms)

Bond forming is exothermic (energy is released as bonds form)

(c)

	Melting Point ºC	**Solubility in Water**	**Bonding Between Particles**
SiO_2			Covalent
Br_2			Weak intermolecular

SiO_2 is made of covalently bonded Si and O atoms. Which form a solid with very srong covalent bonds. The strength of these bonds means that SiO_2 has a high melting point (because it needs a large amount of energy to break its strong covalent bonds). Similarly, the strength of these bonds makes them too strong to be broken by attraction to water molecules, meaning that SiO_2 is not soluble in water.

Br_2 is held together by weak intermolecular forces. This means that it has a low melting point, as these intermolecular forces do not require a large amount of energy to be broken. Similarly the attraction to water molecules is sufficient to separate the bromine molecules (ie the water molecules have a greater attraction than the intermolecular forces).